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DLA PIPER US LLP
1999 AVENUE OF THE STARS
SUITE 400
LOS ANGELES, CA 90067-6023

EXAMINER	
BROOME, SAID A	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/783,201	MUSETH ET AL.
	Examiner	Art Unit
	Said Broome	2628

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 April 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-55* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-53 and 55* is/are rejected.

7)☒ Claim(s) *54* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 April 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This office action is in response to an amendment filed on 4/5/2007.

2. Claims 1, 4, 5 and 8 have been amended by the applicant.

3. Claims 2, 3, 6, 7 and 9-55 are original.

Drawings

The drawings were received on 4/5/07. These drawings are accepted.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 5, 45, 46, 48 and 51-53 are rejected under 35 U.S.C. 102(b) as being anticipated by Whitaker et al.(hereinafter "Whitaker", "*A Framework for Level Set Segmentation of Volume Datasets*").

Regarding claim 1, Whitaker describes a method for editing a geometrical model with a level set modeling surface editor operator in the abstract lines 1-8. Whitaker also describes defining a level set model having at least one deformation thereon to be modified in section 3 2nd ¶ lines 5-10 ("*...the level set formulation provides a set of numerical methods that describes how to manipulate...a volume...*"). Whitaker describes performing a level set surface editing

operation on a level set surface model, where the operation is defined by a level surface editing operator in section 3 2nd ¶ lines 3-7 ("*...the surface deformation process moves the surface model...One must choose those properties of the input data to which...the shape of the model will have in the deformation...*"), as shown in Figure 5, where it is described that a user is given the choice of whether to apply particular data to the surface deformation in section 4.2 1st ¶ lines 5-7 ("*One must choose those properties of the input data to which the model will be attracted...in the deformation process...There are a variety of surface-motion terms that can be used...*"), therefore the edge data disclosed in the 3rd ¶ of section 4.2 could be excluded from the deformation operation performed on the level set model surface. Whitaker also describes that an operation modifies the at least one deformation in section 6 1st ¶ lines 3-5.

Regarding claim 2, Whitaker illustrates converting an input model into said level set model for said step of performing a level set surface editing operation in Figure 6, where it is shown that the input model is modified to produce, and therefore render, a level set model.

Regarding claim 3, Whitaker describes converting the input model from a geometric to a volumetric model by using scan conversion on page 5 left column first paragraph lines 9-10 ("*The user then creates a Constructive Solid Geometry (CSG) model which defines the shape of the initial surface...The CSG model is scan-converted into a binary volume...*").

Regarding claim 5, Whitaker describes converting the input model using Sethian's Fast Marching Method in section 3 right column fourth paragraph lines 3-4 ("*This static level set approach has been solved...using a "Fast Marching Method".*").

Regarding claim 45, Whitaker describes the level surface editing operator is a morphological editing operator in section 4.1.1 right column third paragraph lines 1-5 ("*For the*

results in the paper we implement openings and closings using morphological propagators...implemented with level set surface models.").

Regarding claim 46, Whitaker describes volume rendering in the abstract lines 5-8 ("*The level set segmentation method...creates a new volume from the input data by solving an initial-value partial differential equation (PDE) with user-defined feature-extracting terms.*"), and the rendered volume is also shown in Figure 6.

Regarding claim 48, Whitaker describes the input model as a 3D object in the abstract lines 1-3 ("*This paper presents a framework for extracting surface models from a broad variety of volumetric datasets. These datasets are produced from standard 3D imaging devices...*"), and can therefore be a polygon mesh as shown in Figure 2b.

Regarding claim 51, Whitaker describes that the input model may be a Constructive Solid Geometry (CSG) model on page 5 left column first paragraph lines 9-10 ("*The user then creates a Constructive Solid Geometry (CSG) model which defines the shape of the initial surface...*"), and as shown in Figure 7.

Regarding claim 52, Whitaker describes that the 3D models, which are input, as described in the abstract lines 5-8 ("*The level set segmentation method...creates a new volume from the input data...*"), are represented using implicit models, as described in section 3 first paragraph lines 1-6 ("*When considering deformable models for segmenting 3D volume data, one is faced with a choice from a variety of surface representations...Another option is an implicit level set model...*"), and as illustrated in Figure 5.

Regarding claim 53, Whitaker describes input models as a scanned volume in the abstract lines 1-5 ("*This paper presents a framework for extracting surface models from a broad variety*

of volumetric datasets. These datasets are produced from standard 3D imaging devices…"), and as shown in Figures 1-4.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 4, 6 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitaker in view of Breen et al.(hereinafter "Breen", "*3D Scan Conversion of CSG Models into Distance Volumes*").

Regarding claim 4, Whitaker fails to teach the limitations. Breen teaches converting an input model by using distance calculations in section 1 right column second paragraph lines 1-7 ("*When 3-D scan converting a geometric model to a volumetric representation…we propose the use of distance volumes. A distance volume is a volume dataset where the value stored at each voxel is the shortest distance to the surface of the object being represented by the volume.*"). It would have been obvious to one of ordinary skill in the art to combine the teachings of Whitaker with Breen because this combination would provide accurate conversion of input geometric models into volumetric models through calculation of distances between points or voxels of the data.

Regarding claim 6, Whitaker fails to teach the limitations. Breen teaches the level set model is represented in a narrow-band distance volume in section 3.2.1 second paragraph lines 1-

11 ("*Sethian…has developed a Fast Marching Level Set Method…The distance values in the remainder of the volume are computed by pushing this narrow band outward.*"), where it is described that the level set method applied to the model is represented using narrow band distance values of the volume. The motivation to combine the teachings of Whitaker and Breen is equivalent to the motivation of claim 4.

Regarding claim 20, Whitaker fails to teach the limitations. Breen teaches the level surface editing operator is a CSG intersection operator in Table 2. The motivation to combine the teachings of Whitaker and Breen is equivalent to the motivation of claim 4.

Regarding claim 21, Whitaker fails to teach the limitations. Breen teaches the level surface editing operator is a CSG difference operator in Tables 3 and 4. The motivation to combine the teachings of Whitaker and Breen is equivalent to the motivation of claim 4.

Regarding claim 22, Whitaker fails to teach the limitations. Breen teaches the level surface editing operator is a CSG union operator in Table 1. The motivation to combine the teachings of Whitaker and Breen is equivalent to the motivation of claim 4.

Claims 7-26, 30-35, 39, 40, 44 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitaker in view of Museth et al.(hereinafter "Museth", "*Level Set Surface Editing Operators*").

Regarding claim 7, Whitaker teaches a level set surface editing operator defined a speed function in section 3 right column fifth paragraph lines 1-8 ("*Thus, to summarize the essence of the (dynamic) level set approach; let ds/dt be the movement of a point on a surface as it deforms… where F is a user-defined "speed" term…*"). However, Whitaker fails to teach a

regional constraint function component, filter function component, and a surface properties defining function component. Museth teaches a function that comprises a regional constraint function component, filter function component, and a surface properties defining function component on page 333 left column first paragraph lines 1-11 ("*...speed functions used in our surface editing operators...$D_q(d)$ acts as a region-of-influence function that regionally constrains the LS calculation. $C(\gamma)$ is a filter of the geometric measure and $G(\gamma)$ provides the geometric contribution of the level set surface.*"). It would have been obvious to one of ordinary skill in the art to combine the teachings of Whitaker with Museth because this combination would provide efficient modification of the surface of a model by applying variables that alter the surface geometry of the model at a certain speed, as specified by the speed function.

Regarding claim 8, Whitaker teaches that the speed function contains the term n, which is interpreted to represent a surface normal, in section 4.2 second paragraph lines ("*For the work presented here we use the mean curvature of the isosurface H to form a vector in the direction of the surface normal n...*") and as shown in equation 6. However, Whitaker fails to teach the speed function is $F(x, n, \Phi) = D_q(d)C(\gamma)G(\gamma)$. Museth teaches that the speed function $F(x, n, \Phi) = D_q(d)C(\gamma)G(\gamma)$, in equation 3, where $D_q(d)$ is the regional constraint function component, $C(\gamma)$ is the filter function component, $G(\gamma)$ is the surface properties, as described on page 333 left column first paragraph lines 1-11, Φ is an iso-surface in section 4 1st ¶ lines 3-4, and n is a normal in section 4.1 1st lines 5-13 ("*...n...are the...normal vectors...on the surface...function...defines the...level set surface in the direction of the local normal n...*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 9, Whitaker fails to teach the limitations. Museth teaches *q* being defined as a geometric primitive such as a point and notion *d* represents a distance from the level set surface model to *q* on page 333 section 4.2 second paragraph lines 1-3 ("*...d is a distance measure from a point on the level set surface to the ROI primitive q.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 10, Whitaker fails to teach the limitations. Museth teaches that *y* is a geometric property of the level set surface of the level set model and is an order property of Φ, which represents the level set surface, in section 4.1 2nd ¶ lines 9-15 ("*...a function...depends on geometric measures y derived from the level set surface...y is defined as zero, first, or second order measures of the LS surface.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 11, Whitaker fails to teach the limitations. Museth teaches that *y* represents a zero-th order property of Φ that represents the level set surface, in section 4.1 2nd ¶ lines 9-15 ("*...y is defined as zero...order measures of the LS surface.*"), where the zero-th order property may represent distance, as described in section 4.3 1st ¶ lines 1-3 ("*The zero order geometric property that we utilize is...distance...*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 12, Whitaker fails to teach the limitations. Museth teaches that *y* represents a first order property of Φ that represents the level set surface, in section 4.1 2nd ¶ lines 9-15 ("*...y is defined as...first...order measures of the LS surface.*"), where the first order property may represent a normal vector, as described in section 4.3 1st ¶ lines 1-4 ("*We calculate a number of geometric properties from the level set Surface...The first order property is the*

surface normal…"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 13, Whitaker fails to teach the limitations. Museth teaches that y represents a second order property of Φ that represents the level set surface, in section 4.1 2nd ¶ lines 9-15 ("*…y is defined as…second…order measures of the LS surface.*"), where the second order property may represent curvature, as described in section 4.3 1st ¶ lines 1-5 ("*We calculate a number of geometric properties from the level set Surface…Second order information includes a variety of curvature measures of the LS surface.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 14, Whitaker fails to teach the limitations. Museth teaches the regional constraint component defining a region-of-influence on page 333 left column first paragraph lines 1-11 ("*…$D_q(d)$ acts as a region-of-influence function that regionally constrains the LS calculation…*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 15, Whitaker fails to teach the limitations. Museth teaches a region-of-influence that is defined by a distance calculation to a geometric primitive, on page 333 section 4.2 second paragraph lines 1-3 ("*…d is a distance measure from a point on the level set surface to the ROI primitive q.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 16, Whitaker fails to teach the limitations. Museth teaches a region-of-influence defined by a distance to an intersection curve point set on page 334 right column first paragraph lines 9-11 ("*…defining the region of influence based on the distance to the*

intersection curve shared by both input surfaces."). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 17, Whitaker fails to teach the limitations. Museth illustrates a super-ellipsoid region-of-influence in section 5.4 first paragraph lines 5-8 ("...*the user encloses the region to be embossed with a ROI primitive e.g. a superellipsoid.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 18, Whitaker fails to teach the limitations. Museth teaches a filter function for local geometric properties in section 4.1 2nd ¶ line 12 ("...*C(y) is a filter of the geometric measure*...") and in section 4.2 1st ¶ lines 1-2 ("...*our surface operators may be applied locally in a small user-defined region on the edited surface.*"), in which a user may control the behavior of the editing of a level set surface based on a function of a local geometric surface property in section 1.3 lines 6-14 ("...*level set speed functions*...*implement*...*surface editing operators*...*The user specifies the local geometric properties of the resulting surface modifications.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 19, Whitaker fails to teach the limitations. Museth teaches that the surface properties defining function component defines the behavior of the level set surface editing operator on page 333 left column first paragraph lines 1-11 ("...*speed functions used in our surface editing operators*...*G(γ) provides the geometric contribution of the level set surface.*")., where it is described that the speed function that applies deformation to the surface is applied to the surface of the model and therefore defines the behavior of the surface. The

motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 20, Whitaker fails to teach the limitations. Museth illustrates that the level set surface editing operator is a CSG intersection operator in Table 2. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 21, Whitaker fails to teach the limitations. Museth illustrates that the level set surface editing operator is a CSG difference operator in Table 2. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 22, Whitaker fails to teach the limitations. Museth illustrates that the level set surface editing operator is a CSG union operator in Table 2. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 23, Whitaker fails to teach the limitations. Museth illustrates a level surface editing operator as a blending operator in the equation shown in equation 8, and the blending is shown to be constrained by a region-of-influence in Figure 5. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 24, Whitaker fails to teach the limitations. Museth teaches the region-of-influence is based on the distance to an intersection curve shared by both input surfaces on page 334 right column first paragraph lines 9-11 ("*...defining the region of influence based on the distance to the intersection curve shared by both input surfaces.*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 25, Whitaker fails to teach the limitations. Museth teaches the intersection curve is represented by a point set on page 334 right column first paragraph lines 14-

16 ("*...approximate representation of the intersection curve as a point set to be sufficient for defining a shortest distance d for the region-of-influence...*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 26, Whitaker fails to teach the limitations. Museth teaches the blending operator is defined by the function $F_{blend}(x, n, \Phi) = \alpha D_q(d)C(K)K$ in equation 8, wherein α is a user-defined positive scalar that controls the rate of the level set calculation, $D_q(d)$ is said region-of-influence component with d being the shortest distance from the level set surface to said intersection curve point set; K is a curvature term; and $C(K)$ is a filtering function that defines the geometric properties of said blending operator on page 334 right column second paragraph lines 1-10 ("*The blending operator moves the surface in a direction that minimizes a curvature measure, K, on the level set surface...where α is a user-defined scalar...where d is the shortest distance from the level set surface to the intersection curve...where C(K) is given by Eq. (7)...*") and on page 333 section 4.3 second paragraph lines 4-6 ("*C( ) allows the user to slow and then stop the level set deformation as a particular surface property...*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 30, Whitaker teaches a smoothing operator or term, where the surface is smoothed by applying motions in a direction that reduces local curvature in section 4.2 first paragraph lines 1-9 ("*The initialization should position the model near the desired solution while retaining certain properties such as smoothness...Given a rough initial estimate, the surface deformation process moves the surface model toward specific features in the data...the deformation process combines a data term with a smoothing term, which prevents the solution*

from fitting too closely to noise-corrupted data. There are a variety of surface-motion terms that can be used…").

Regarding claim 31, Whitaker fails to teach the limitations. Museth teaches a smoothing operator is constrained to move outward relative to said surface to smooth said surface by adding material to said surface on page 334 left column first paragraph lines ("*…we can simply redefine the speed function as…max (G,0)to add material (outward motion only)…*"), as shown in Figure 7. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 32, Whitaker fails to teach the limitations. Museth teaches a smoothing operator is constrained to move inward relative to said surface to smooth said surface by removing material to said surface on page 334 left column first paragraph lines ("*…we can simply redefine the speed function as min (G,0)to remove material (inward motion only)…*"), as shown in Figure 8. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 34, Whitaker fails to teach the limitations. Museth teaches the blending operator is defined by the function $F_{smooth}(x, n, \Phi) = \alpha D_s(d)C(K)K$ in equation 8, wherein α is a user-defined positive scalar that controls the rate of the level set calculation,; K is a curvature term; and $C(K)$ is a filtering function that defines the geometric properties of said blending operator on page 334 right column second paragraph lines 1-10 ("*The blending operator moves the surface in a direction that minimizes a curvature measure, K, on the level set surface…where α is a user-defined scalar…where d is the shortest distance from the level set surface to the intersection curve…where C(K) is given by Eq. (7)…*") and on page 333 section 4.3 second

paragraph lines 4-6 ("*C( ) allows the user to slow and then stop the level set deformation as a particular surface property...*"). Museth teaches that $D_s(d)$ ensures that said function smoothly goes to zero near the boundary of the region-of-influence on page 335 left column first paragraph lines 12-14 ("*...$D_s(d)$ ensures that the speed function smoothly goes to zero as x approaches the boundary...*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding clam 35, Whitaker fails to teach the limitations. Museth teaches that the region-of-influence of said is defined by a distance calculation to a geometric primitive on page 335 right column second paragraph lines 2-8 ("*...point sets can be samples of lines, curves, planes, patches and other geometric shapes...The region-of-interest function for this operator is $D_s(d)$...* "). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 39, Whitaker fails to teach the limitations. Museth teaches that a region-of-influence is a super ellipsoid on pg. 6 left column 1st ¶ lines 3-4 ("*We use superellipsoids..as a...ROI primitive...*"). The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 40, Whitaker fails to teach the limitations. Museth teaches a level surface editing operator as a point set attraction/repulsion operator in section 5.4 1st ¶ line 1 ("*We have developed an operator that attracts and repels the surface...*") and ins shown in Figure 8. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 44, Whitaker fails to teach the limitations. Museth teaches that the point set attraction/repulsion operator is used to emboss a surface in the caption of figure 8 lines 1-3 ("*Figure 8...single point attractions/repulsions using different ROI primitives... Utah teapot embossed with 7862 points...*"), as shown in Figure 8. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Regarding claim 55, Whitaker fails to teach the limitations. Museth teaches level set computations associated with solving a speed function are regionally constrained to a sub-volume in section 1.3 2nd ¶ lines 1-12 ("*The definition of level set speed functions that implement...surface editing operators...Smoothing...are constrained to occur within a user-specified region...The user specifies the local geometric properties of the resulting surface modifications...*"), which is defined by a 3D object placed around a region-of-influence primitive, as described in section 4.2 1st ¶ lines 2-9 ("*...to regionally restrict the deformation during the level set computation...involves defining the region of influence...by...user interactively placing a 3D object around the region...*"), therefore the 3D object placed around the region-of-influence, as shown in Figure 9, could be a bounding box. The motivation to combine the teachings of Whitaker and Museth is equivalent to the motivation of claim 7.

Claims 27-29, 36-38 and 41-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitaker in view of Museth in further view of Applicant's Admitted Prior Art (hereinafter "AAPA").

Regarding claims 27, 36 and 41, Whitaker fails to teach the limitations. Museth teaches that a blending operator calculates a closest point in a set in section 5.2 1st ¶ lines 3-4, 17-19 and

in 2nd ¶ lines 1-9 ("*We…improve…region of the surface by applying an automatic localized blending…involves defining the region of influence based on…distance…for defining a shortest distance d for the region-of-influence function, Dp(d), cf. Eq. (3)…Dp(d) is defined in Eq. (6a) where d is the shortest distance from the level set surface to the…point set…*"). However, Whitaker and Museth fail to teach calculating a closest point in a set by using the approximate nearest neighbor search algorithm of Mount and Arya. AAPA teaches calculating a closest point in a set by using the approximate nearest neighbor search algorithm of Mount and Arya on pg. 32 lines 13-23. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to combine the teachings of Whitaker, Museth and AAPA because this combination would provide smooth blending between distorted cracks or creases on the surface of a model, through determining threshold distances in which to perform the blending operations, thereby ensuring jumps and visual artifacts are avoided during blending.

Regarding claims 28, 29, 37, 38, 42 and 43, Whitaker fails to teach the limitations. Museth teaches that a blending operator calculates a closest point in a set in section 5.2 1st ¶ lines 3-4, 17-19 and in 2nd ¶ lines 1-9. However, Whitaker and Museth fail to teach calculating a closest point in a set by storing a point set in a K-D tree, wherein points in the point set are uniform distributed. AAPA teaches calculating a closest point in a set by storing a point set in a K-D tree, wherein points in the point set are uniform distributed on pg. 32 line 24 – pg. 33 lines 1-6. The motivation to combine the teachings of Whitaker, Museth and AAPA is equivalent to the motivation of claim 27.

Claims 49 and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitaker in view of Mauch ("*A Fast Algorithm for Computing the Closest Point and Distance Transform*").

Regarding claim 49, Whitaker teaches calculating the closest point on and shortest singed distance to the surface of the model by solving the Eikonal equation | V Φ| = 1, in section 3.2.1 first paragraph lines 5-6 – second paragraph lines 1-11 ("*...closest point on the surface S are the endpoints of this line segment...a Fast Marching Level Set Method to solve the Eikonal equation...the solution gives the signed distance from the surface S.*") and as shown in equation 13. However, Whitaker fails to teach a polygon mesh that is scan converted into a level set model by computing a distance. .Mauch teaches teach a polygon mesh that is scan converted into a level set model by computing a distance, in the abstract lines 5-10 ("*We consider manifolds composed of simple geometric shapes, such as, a set of points, piecewise linear curves or triangle meshes...The method of characteristics is implemented efficiently with the aid of computational geometry and polygon/polyhedron scan conversion.*") and on page 2 sixth paragraph lines 1-3 ("*The distance and closest point transforms are important in several applications...The distance transform can be used to convert an explicit surface into a level set representation of the surface.*"). It would have been obvious to one of ordinary skill in the art to combine the teachings of Whitaker with Mauch because this combination would provide an accurate representation of a level set model through utilizing scan conversion and closest point calculations.

Regarding claim 50, Whitaker fails to teach the limitations. Mauch teaches computing a distance volume using a CPT(closest point) algorithm in the abstract lines 1-6 ("*This paper*

presents a new algorithm for computing the closest point transform to a manifold on a rectilinear grid in low dimensional spaces... We consider manifolds composed of simple geometric shapes, such as, a set of points, piecewise linear curves or triangle meshes."). The motivation to combine the teachings of Whitaker and Mauch is equivalent to the motivation of claim 49.

Allowable Subject Matter

Claim 54 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art, Whitaker, Breen, Museth and Mauch do not teach the following limitations of claim 54: resetting the volumetric representation of said level model after said step of performing a level set surface editing operation to ensure that Φ is approximately equal to the shortest distance to the zero level set in the narrow band.

Response to Arguments

Applicant's arguments with respect to claims 1-55 have been considered but are moot in view of the new ground(s) of rejection.

In regards to the arguments recited on page 13 in the 2nd ¶ lines 1-2, the objection to claims 4 and 5, for minor grammatical errors, have been withdrawn based on the amendments to claims 4 and 5.

In regards to the arguments recited on page 13 in the 3rd ¶ lines 1-2, related to the 35 U.S.C. 112 rejection of claims 8-19 and 54, have been withdrawn based on the amendment to claim 8.

The 35 U.S.C. 101 rejection of claims 1-55 has been withdrawn due to the amendment to claim 1, and with respect to the current interpretation of 35 U.S.C. 101 in which as long as a practical application is claimed or disclosed in the Specification, the claims are statutory.

The applicant argues that the reference Whitaker used in the 35 U.S.C. 102(b) rejection of claim 1 does not teach editing a surface once it is derived. However, the examiner maintains the rejection because Whitaker teaches editing a surface once it is derived in section 4 1st ¶ lines 1-2 ("*Our level set...process has two major stages, initialization and level set surface deformation...*") and in section 6 1st ¶ lines 3-5 ("*Level set surface modeling...allows one to manipulate or deform the isosurfaces of a volume...*"), where the level set surface is first defined, and then edited by performing a deformation on the level set surface, as shown in Figures 5(b) and 7(c).

The applicant also argues that the reference Whitaker used in the 35 U.S.C. 102(b) rejection of claim 1 does not teach editing a surface without edge terms. The examiner maintains the rejection because Whitaker teaches that the terms utilized for editing a surface may be selectively chosen in section 4.2 1st ¶ lines 5-7, therefore the edge data disclosed in the 3rd ¶ of section 4.2 could be excluded from the editing operation performed on the level set model surface.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Said Broome whose telephone number is (571)272-2931. The examiner can normally be reached on M-F 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571)272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Said Broome/
Art Unit 2628
6/28/07

Ulka Chauhan
Supervisory Patent Examiner

KEE M. TUNG
SUPERVISORY PATENT EXAMINER